IJBPAS, October, 2026, 15(10): 4883-4892

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EFFECT OF ANTIDIABETIC THERAPY AND DRUG INTERACTIONS IN PATIENT WITH HYPERTENSION AND KIDNEY DISEASE

PAUL M[1], KUMAR PP[2], NIKHIL RAJ. S. K[*], BHATTACHARJEE A[4] AND SYED MA[5]

Mallige College of Pharmacy Bangalore-560090, India

***Corresponding Author: Dr. Nikhil Raj.S. K: E Mail: nikhilrajsk6@gmail.com**

Received 25th Dec. 2025; Revised 26th Jan. 2026; Accepted 15th May 2026; Available online 1st Oct. 2026

https://doi.org/10.31032/IJBPAS/2026/15.10.10529

ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM), is indicated as persistent hyperglycemia and usually associated with hypertension and chronic kidney disease (CKD), which generates the need for improving the therapeutical approach in treating the Diabetes. This study shows the safety and efficacy of oral versus systemic antidiabetic treatments in T2DM patients with these comorbidities.

Methods: A prospective and retrospective observational study at Mallige Hospital, Bengaluru, enrolled 301 T2DM patients (177 males, 124 females, aged >30 years). Patients were organized based on therapy (oral, systemic, combination) and comorbidities, the results were comprising side effects, and drug interactions. Data were analyzed using SPSS.

Results: Combination therapy significantly improved blood glucose ($p<0.05$) compared to monotherapy, particularly in patients with hypertension (42.8%) and CKD (26.9%). Systemic therapies had more side effect rates (47.5%) than oral therapies (21.9%), with hypoglycemia predominant. Patients with severe kidney disease were few (n=18), suggesting other factors influencing the results. Metformin and SGLT2 inhibitors were effective for eGFR ≥30 mL/min/1.73 m², while insulin was preferred for severe cases.

Conclusion: Combination therapy improves the glycemic control in T2DM with hypertension and CKD but increases the side effect risks, notably hypoglycemia. Oral therapies, involving metformin and SGLT2 inhibitors, are safer for stable patients, while systemic therapies are

necessary for severe hyperglycemia. Personalized treatment, accounting for drug interactions and comorbidity profiles, is critical. Future studies should assess long-term outcomes and newer agents like GLP-1 receptor agonists.

Keywords: Type 2 Diabetes Mellitus, Antidiabetic Therapy, Hypertension, Chronic Kidney Disease, Glycemic Control, Drug Interactions

INTRODUCTION:

Type 2 Diabetes Mellitus is a chronic disorder which is characterized by the constant Hyperglycemia due to impaired secretion of insulin, insulin action or both **[1]**. The most common symptoms in patients with T2DM is increased thirst, increased frequency of urination, lack of energy and tiredness, fungal and bacterial infection, and prolonged wound healing **[2]**. Diabetes mellitus has complications like acute complications, Diabetic ketoacidosis **[3]**, Hypoglycaemia **[4]**, Hyperglycaemia **[5]**, and Chronic complications like Diabetic retinopathy **[6]** Diabetic Neuropathy **[7]**, Diabetic nephropathy **[8]** and Hyperglycemic hyper osmolar state **[9]**.

Type 2 diabetes has risen drastically worldwide. In 1990 it was the 18th leading cause of death, but by 2017 it had become the 9th, affecting about 462 million people (6.3 % of the world's population) with over 1 million deaths each year. The burden is highest in developed regions such as Western Europe but is rising quickly in lower-income countries too. Males show slightly higher rates than females, and incidence peaks around age 55. Without stronger prevention measures, global prevalence is forecast to increase from about 6,059 cases per 100,000 in 2017 to more than 7,000 per 100,000 by 2030 and nearly 7,900 per 100,000 by 2040 **[10]**.

Antidiabetics causing more drug interactions are from sulfonylureas and meglitinides classes which are widely used for the treatment of type 2 diabetes mellitus because they help in releasing insulin from pancreas, but these class of drugs are highly associated with the risk of hypoglycemia. Angiotensin converting enzyme inhibitors (ACEI) are advised by the physician for the patients with comorbidities. The combination of ACEI with sulfonylureas and meglitinides may increase the occurrence of hypoglycemia in patients **[11]**.

MATERIALS AND METHODS:

Study design and setting

A prospective and retrospective observational study was conducted at Mallige Hospital, Bengaluru, Karnataka India, in 2025. The Institutional Ethics Committee approved with the approval number MCP/RRB/019/24-25 from RRB and informed consent forms were obtained from patients.

Study population

We enrolled 301 T2DM patients aged >30 years, diagnosed per standard criteria, receiving oral (e.g., metformin, sulfonylureas), systemic (insulin), or combination therapies. Patients with hypertension, kidney disease were included; those with type 1 diabetes, pregnancy, or incomplete records were excluded.

Data collection

Data from prescription charts, medical records, and laboratory reports included demographics, hospital stay, comorbidities. Data has been recorded using patient forms.

OUTCOME MEASURES

Primary outcome: To evaluate the appropriateness and also to determine the most frequently prescribed antidiabetic medication.

RESULTS:

Age vs gender:

A total of 301 patients were included in the analysis, comprising 177 males (58.63%) and 124 females (41.04%). In the male patient population, most Anti-Diabetics used in age group of 60-69 years accounting for 21.59% (n=65) of male, followed by 50-59 years (n=44, 14.61%) and 70- 79 years (n=37, 12.29%), while, the most common age group among females was also 60-69 years (n=39, 12.95%), followed by 70-79 years (n=30, 9.9%) and 50-59 years (n=25, 8.30%). Both males and females were in the same number within the age 40-49 (n=17, 5.64%). Very few were under the age of 40, with only 0.6% of females and 1.6% of males falling within the 30-39-year range as shown in **Figure 1**. Suggesting that diabetes treatment was most concentrated in individuals aged 50-79 years, and also slightly more male patients were affected overall.

Stay in hospital:

Out of the 301 individuals, around 170 patients (56.4%) stayed for just 1 to 3 days, while 115 patients (38.2%) were admitted for 4 to 6 days and 10 patients (3.32%)—had a hospital stay of 7 to 9 days, and only 6 individuals (1.99%) admitted for 10 days or more as in **Figure 2**. Overall, this shows that the majority of patients were treated and discharged within a few days of admission i.e., 1-3 days.

Anti-diabetic used:

A total of 301 diabetic patients were treated with different medications. About 27% are on oral drugs alone, while 34% use only injectable (systemic) medicines. The largest group, 39%, needs a mix of both oral and systemic treatments according to **Figure 3**. This suggests that many patients require combination therapy for better blood sugar control, reflecting the need for personalized care as diabetes progresses.

Side-effects and gender:

In a population of 301 patients, 104(34.55) experienced side effects. Out of 177 male patients, 42 (23.7%) experienced side-

effects from systemic anti-diabetics, while 18(10.16%) reported side-effects from oral anti-diabetics, totaling 60 males (33.8%) who experienced side-effects. Among the 124 female patients, 33(26.6%) had side-effects from systemic anti-diabetics, and 11(8.8%) from oral anti-diabetics drugs, amounting to 44 females (35.4%) affected shown in **Figure 4**. Overall, systemic anti-diabetics were associated with more side-effects than oral agents in both genders, and the incidence of side-effects was slightly higher in males.

Drug interaction severity:

This depicts the severity of drug interactions observed in 186 diabetes mellitus patients who are undergoing treatment with antidiabetic medications. Among these patients, Major interactions were identified in 12 patients from Insulin with Thiazolidinediones leading to Hypoglycemia and Metformin with acetazolamide causing to dizziness which are classified as highly unsafe interactions, while moderate interactions occurred in 170 patients from Insulin and Glimepiride with Beta-blockers(metoprolol) both leading to Hypoglycemia requiring clinical observation during therapy as displayed in **Figure 5**.

Out of the 301 patients included in the study, pharmacodynamic interactions were observed in 74 individuals. Among these, Synergistic interactions have occurred in 20 patients (27%) which it shows Insulin with Thiazolidinediones and Metoprolol leads to Hypoglycemia. Antagonistic interactions were seen in 33 patients (44.6%) which are from Insulin with dexamethasone leading to Hyperglycemia and Insulin with furosemide leading to Hypoglycemia. These results highlight the importance of careful drug selection and close monitoring to avoid potential negative effects in clinical practice. An analysis of pharmacokinetic drug interactions in 57 diabetic patients receiving antidiabetic therapy revealed varying and the most frequent interactions were observed during the absorption phase, affecting 22 patients (38.59%) from Metformin with Hydrochlorothiazide leading to Hypoglycemia, suggesting a high likelihood of altered drug uptake when multiple drugs are co-administered. While Elimination-related interactions were the next most common, seen in 18 patients (31.57%) by drugs like Dapagliflozin with Metoprolol causing Hyperglycemia, potentially impacting drug clearance and leading to accumulation.

AGE VS GENDER

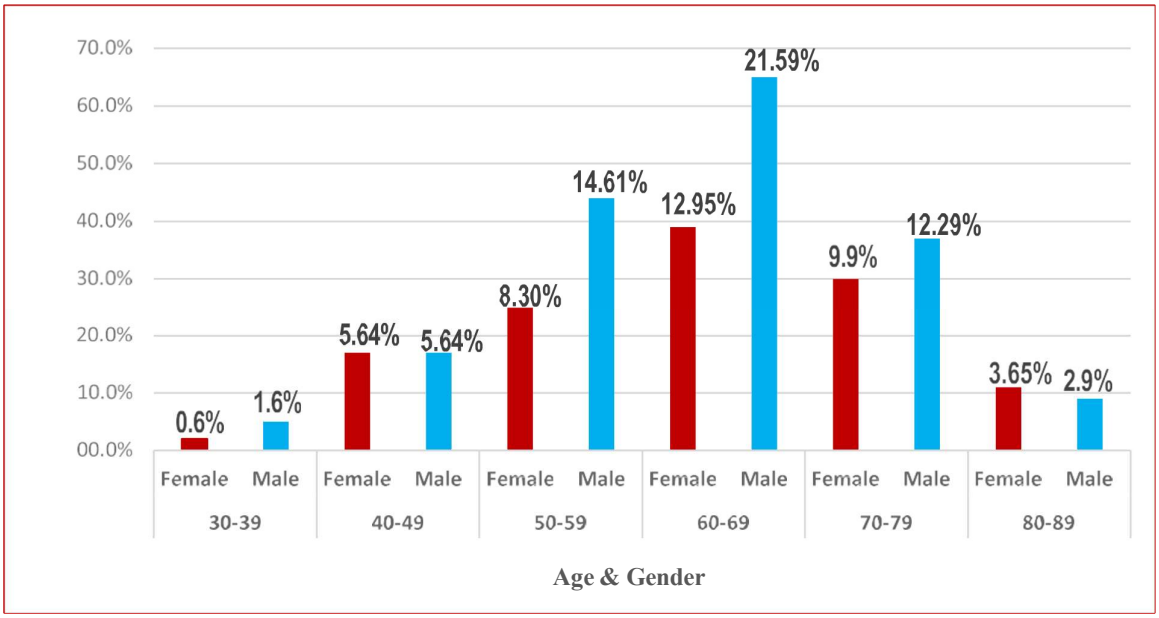

Figure 1: Number of patients based on gender prescribed antidiabetic therapy in certain age groups in 301 patient population

STAY IN HOSPITAL

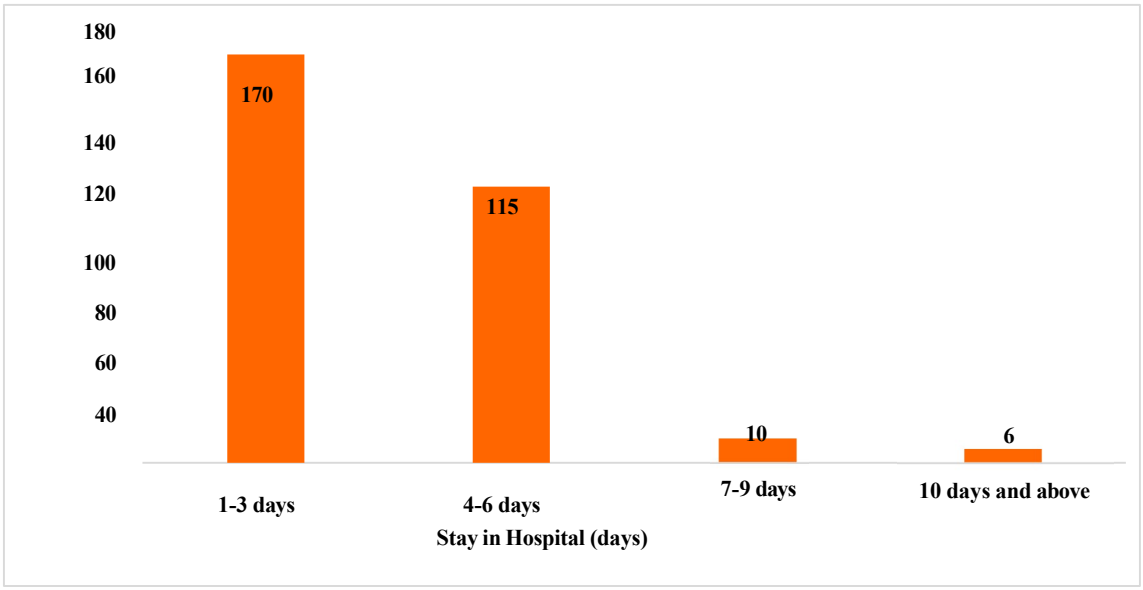

Figure 2: Number of patients staying in the Hospital based on the number of days

ANTI-DIABETIC USED

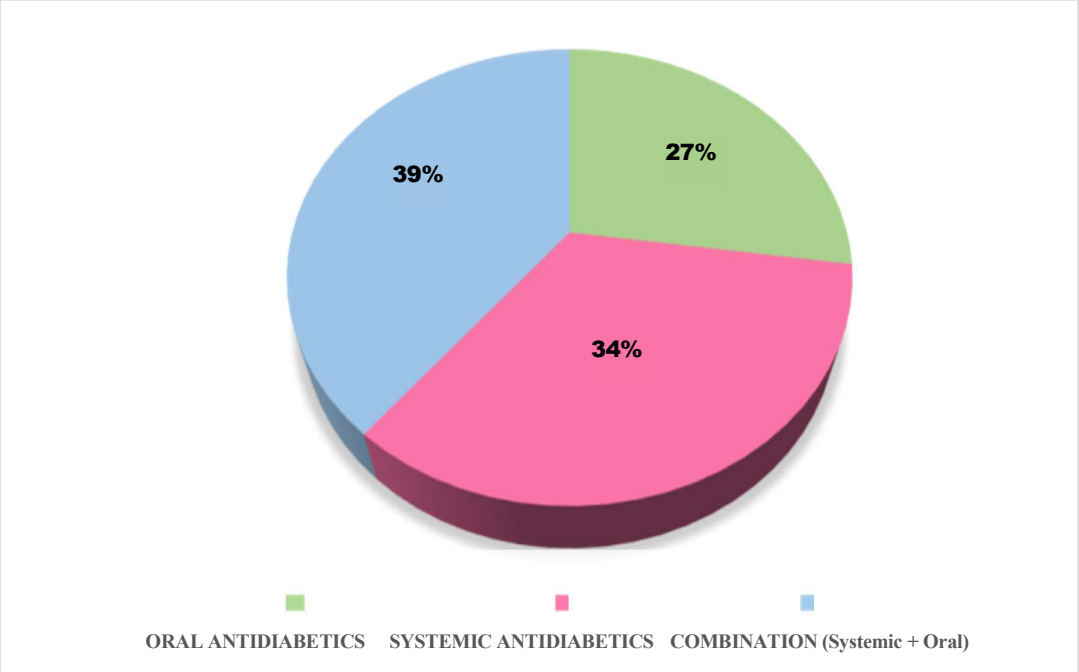

Figure 3: Number of patients distribution based on Anti-diabetic therapy

SIDE-EFFECTS AND GENDER

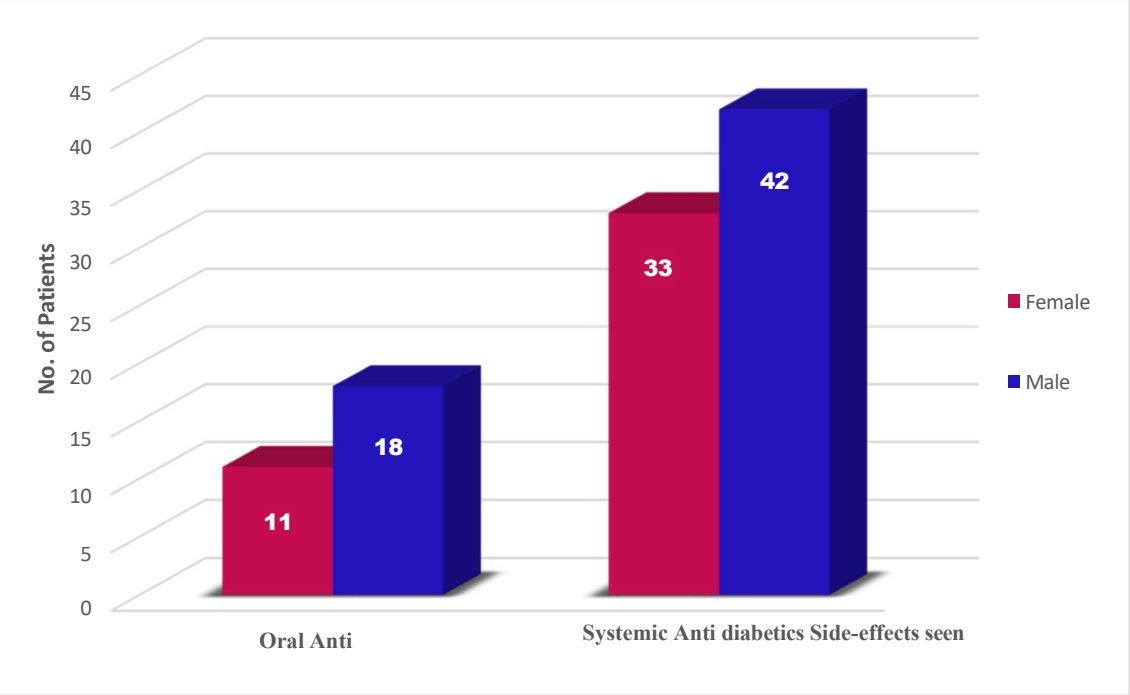

Figure 4: Comparison of Side Effects Between Oral and Systemic Anti-diabetics Treatment Among Male and Female Patients

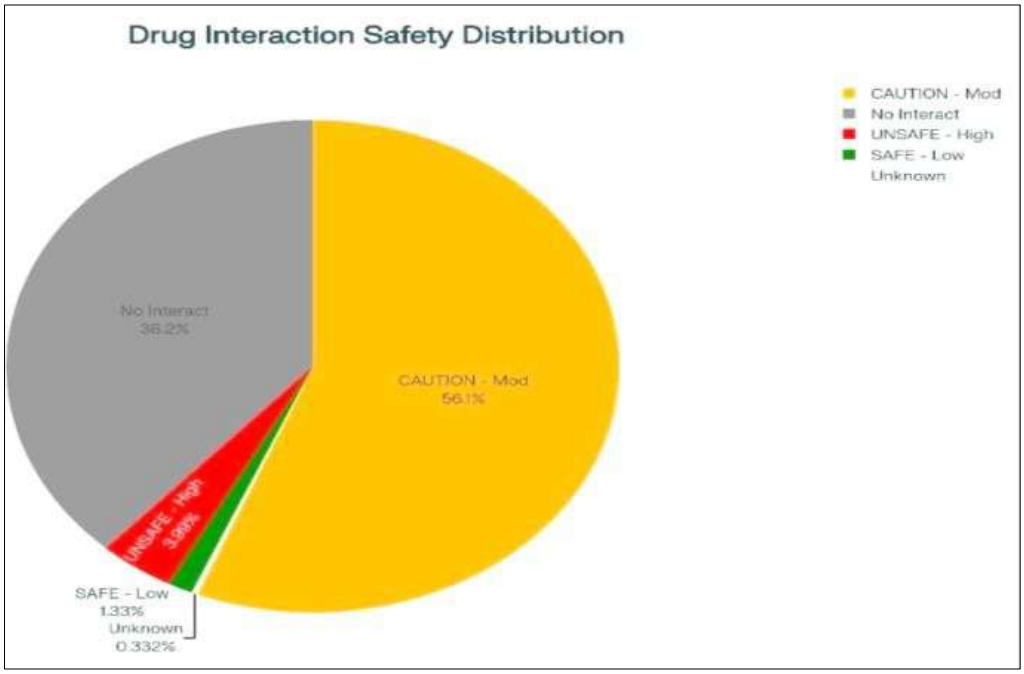

Figure 5: Drug interaction risk profile: Clinical safety distribution among the patient population

DISCUSSION:

Our study population showed a higher rate of males (of age 60-69) contributing to diabetes mellitus along with comorbidities like hypertension and kidney disease, this data closely resembles to "Twin Epidemic" data reported by Singh *et al* 2025 **[12]** who found that Indian population particularly males have increased risk of Diabetes and Hypertension.

Our study suggests that combination therapy of Oral and Systemic Anti Diabetics provide better outcome than Monotherapy which clearly correlates with Bharthi *et al* 2025 **[13]** which says Insulin was later added along with Oral Anti diabetics drugs for handling complicated cases which were not showing significant improvement under monotherapy but it evidently proves that systemic therapy have higher frequency of adverse effects particularly Hypoglycemia than Oral therapy. Supporting this study Raghavan *et al* 2024 **[14]** also describes that Hypoglycemia is an associated risk across Insulin regimens.

Our drug interaction data suggests that 92 % drug interaction were found to be moderate severity, which clearly shows risk of increased Polypharmacy burden highlighted by Munisamy *et al* 2025 **[15]** saying Sulfonylureas and Insulin combination leads to Glycemic variability. The Prevalence of antagonistic interactions and pharmacokinetic interactions especially in case of absorption and elimination clearly correlates with the Ping Tao *et al* 2024 **[16]**, reporting on CKD related drug handling issues and also highlights the need for dose

adjustments in case of renally compromised patients.

CONCLUSION:

This study indicates Systemic Anti Diabetic therapy shows an important role in managing blood sugar level particularly in patients with comorbidities like Hypertension and Kidney disease but these patients are highly prone to experience drug interactions specially with glucocorticoids and beta blockers and adverse effects mainly like Hypoglycemia when compared to other Oral Anti Diabetics. Combination therapy gives optimal blood sugar management leading to reduced hospital stay which clearly shows increased compliance of patient to the given medication. While Male patients showed the majority and has the possibility of experiencing the complications but both genders might experience of similar patterns of adverse effects. Overall, the findings highlight the importance of individualized therapy and increased monitoring the drug interactions and also highlights the importance of following the clinical guidelines for confirming the safety and efficacy in diabetic care mainly in patients with comorbidities (Hypertension and Kidney disease).

ACKNOWLEDGEMENT: The authors are thankful to the help provided by Mallige College of Pharmacy for providing facilities to conduct the research.

REFERENCES

[1] Kharroubi AT, Darwish HM. Diabetes mellitus: The epidemic of century. *World J Diabetes* 2015; 6(6): 850-867. [DOI: 10.4239/wjd.v6.i6.850]

[2] Sastre, M.T.M., Sorum, P.C., Kpanake, L. *et al.* Judging the possibility of the onset of diabetes mellitus type 2 from reported behavioral changes and from family history. *Clin Diabetes Endocrinol* **9**, 1 (2023). https://doi.org/10.1186/s40842-022-00147-w

[3] Elendu C, David JA, Udoyen AO, Egbunu EO, Ogbuiyi-Chima IC, Unakalamba LO, Temitope AI, Ibhiedu JO, Ibhiedu AO, Nwosu PU, Koroyin MO, Eze C, Boluwatife AI, Alabi O, Okabekwa OS, Fatoye JO, Ramon-Yusuf HI. Comprehensive review of diabetic ketoacidosis: an update. Ann Med Surg (Lond). 2023;85(6):2802-2807. *DOI:* 10.1097/MS9.0000000000000894

[4] González-Vidal T, Rivas-Otero D, Gutiérrez-Hurtado A, Alonso Felgueroso C, Martínez Tamés G, Lambert C, Delgado-Álvarez E, Menéndez Torre E. Hypoglycemia in patients with type 2 diabetes

mellitus during hospitalization: associated factors and prognostic value. Diabetol Metab Syndr. 2023;15(1):249. doi: 10.1186/s13098-023-01212-9.

[5] Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, Rosas SE, Del Prato S, Mathieu C, Mingrone G, Rossing P, Tankova T, Tsapas A, Buse JB. Management of Hyperglycemia in Type 2 Diabetes, 2022. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care. 2022; 45(11):2753-2786. doi: 10.2337/dci22-0034.

[6] Wang Z, Zhang N, Lin P, Xing Y, Yang N. Recent advances in the treatment and delivery system of diabetic retinopathy. Front Endocrinol (Lausanne). 2024; 15:1347864. doi: 10.3389/fendo.2024.1347864.

[7] Galiero R, Caturano A, Vetrano E, Beccia D, Brin C, Alfano M, Di Salvo J, Epifani R, Piacevole A, Tagliaferri G, Rocco M, Iadicicco I, Docimo G, Rinaldi L, Sardu C, Salvatore T, Marfella R, Sasso FC. Peripheral Neuropathy in Diabetes Mellitus: Pathogenetic Mechanisms and Diagnostic Options. Int J Mol Sci. 2023 ;24(4):3554. doi: 10.3390/ijms24043554.

[8] Natesan V, Kim SJ. Diabetic Nephropathy - a Review of Risk Factors, Progression, Mechanism, and Dietary Management. Biomol Ther (Seoul). 2021 ;29(4):365-372. doi: 10.4062/biomolther.2020.204

[9] Ray S, Palui R. Managing diabetic ketoacidosis in special conditions: Difficulties and dilemmas. *World J Diabetes* 2025; 16(9): 109053 [DOI: 10.4239/wjd.v16.i9.109053].

[10] Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of Type 2 Diabetes - Global Burden of Disease and Forecasted Trends. J Epidemiol Glob Health. 2020; (1):107-111. doi: 10.2991/jegh.k.191028.001.

[11] Chu PY, Edmondson EK, Flory JH, Huang J, Hennessy S. Risk of Hypoglycemia Associated With Concomitant Use of Insulin Secretagogues and ACE Inhibitors in Adults With Type 2 Diabetes: A Systematic Review. Clin Pharmacol Ther. 2025; 17(4):1005-1011. doi:

10.1002/cpt.3530.

[12] Singh N, Shukla SK, John P, Bajpai R, Chugh P, Sengupta R, Pushkar RR, Yadav N, Singh N, Sadanandan R. Unveiling the twin epidemics of hypertension and diabetes: a cross-sectional analysis of sex-specific prevalence, risk, and hotspots in India's epidemiological transition zones. BMC Public Health. 2025; 25(1):1734. doi: 10.1186/s12889-025-22983-y

[13] Bharti N, Ranjan KR, Singh A. Comparison of the Outcomes of Insulin Therapy Vs Oral Anti Diabetic Agents in Diabetes Management. Int J Curr Pharm Rev Res.2025;17(3);doi.10.5216/ijcprr.v17i3.5051.

[14] Raghavan A, Nanditha A, Satheesh K, Susairaj P, Vinitha R, Nair DR, Snehalatha C, Ramachandran A. A prospective, multicentre, randomized, open-label comparison of a long-acting basal insulin analog glargine plus glulisine with premixed insulin in insulin naïve patients with Type 2 diabetes - A study from India. Prim Care Diabetes. 2024 ;18(2):210-217. doi: 10.1016/j.pcd.2024.01.006.

[15] Venkatachalapathy P, Mohandoss KKDA, Munisamy M, Sellappan M. Comparative Effectiveness of Oral Hypoglycemic Agents for Glycemic Control and Glycemic Variability in Patients with Type 2 Diabetes Mellitus: Using Flash Glucose Monitoring. Curr Diabetes Rev. 2024;21(1):e160124225706. doi: 10.2174/0115733998267817231227102553.

[16] Tao P, Chien CW, Liu C, Zheng J, Sun D, Zeng J, Song Q, Liu Y, Tung TH, Kang L. Diabetes mellitus is a risk factor for incident chronic kidney disease: A nationwide cohort study. Heliyon. 2024;10(7): e28780. doi: 10.1016/j.heliyon.2024